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CONCERNING LOW COST TELEMETRY STATIONS

by

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CONCERNING LOW COST TELEMETRY STATIONS

BY: Li Bangfu
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1. Forward

For a number of years I have often heard a number of customer friends complain that telemetry equipment is too expensive. They say that telemetry equipment is not much more technical or complex than color television, video cameras and PC computers, but the price is many times more expensive, and it is not necessarily very reliable. The answer is naturally very simple: The research costs are high, the cycle is long, production is in small batches, so the cost goes up. This seams to make sense, but the time when the green light is given no matter what the cost is over. Effect to cost and market competition concepts are now in style, and lowering cost is a basic factor that must be considered during equipment development. At the present time, the trends in telemetry system development are for less expensive, smaller, faster and more flexible. The customer will welcome such a system.

Because there is a limited market for telemetry products, large scale production to lower costs is not feasible. However, If a telemetry system can be formed from products which can be supplied from the market, then development cost and the cycle will both be reduced. For example, no one is developing a computer especially for data processing anymore, because there are lots of fine inexpensive computers for sale everywhere. The purpose of this article is to discuss a number of problems related to low cost starting out with this familiar fact.

2. Concerning openness

If the system is to be able to support hardware and software from all different suppliers, and be compatible with the users software and user supplied connections, and be expanded or reduced as necessary, the open type system structure is a basic necessity. This article will not attempt to begin to discuss definitive problems with openness, but will look at the benefits derived from openness from the realistic standpoint. Openness signifies that the system s connected, can be operated by more than one, can be shrunk, can be reused, can be transplanted, has compatibility and can be maintained. Different kinds of support can be provided to the user, allowing the user to make up the system according to his own needs, and can be set up and operating very quickly according to mission requirements. Openness is not only apparent in the operating system or the main line, but is apparent in every aspect of the system such as the data structure, data base, customer interface, communications standards, files and display format. On this basis, it is easy to design a system structure and purchase hardware, software and communications facilities.

There are a number of articles in China and abroad concerning open remote telemetry ground processing systems (see Bibliographic items [1] and [2]. In general, the design of a number of well known systems such as the United States Loral-System550 and the APlabs-VTS and China's basic telemetry system are all based on the principle of openness. As for hardware, because of the use of standard PC and VME main line platforms, the post specifications are open, so it is possible to use many different models from a number of companies to solve the problem of data processing and I/O. For software, it is possible to use UNIX operating system, Xwindow/Motif graphics user interface and TCP/IP net standards, allowing the system's dependence on the hardware platform to be

greatly reduced. For the data bank and information management, Article Nine of the telemetry standards IRIG106-93 stipulates Telemetry Attributes Transfer Standard (TMATS). These standards clearly and entirely define the system data during the obtaining and processing of telemetry information, also called telemetry attributes. Once TMATS are accepted and carried out, information transfer between the designer and the test range through the data bank are much simpler.

There are currently on the market a number of telemetry processing systems, which are limited in their openness. In addition to a VME main trunk, they also have a special main trunk. For example, the Loral-System550's MUXBBus-II and China's Basic Model HDBus. These main lines are all high speed transmission data main lines used to solve the problem of live time high speed data transmission between modules, especially between special telemetry modules. In order to realize broadcast transmission, they use data drive modes, each group of data transmitted on the main line must have a marker added to the corresponding processing module will recognize it, receive it and process this data. Special specifications similar to these limit the use of processors of additional companies. Naturally, with an additional main line there is a corresponding increase in the system's processing speed, and it is easy to support multiple data streams. The APlabs-VME system uses a single VME main line cabinet which allows for the use of several company's processors and I/O modules. Even the telemetry special shunt (including the frame synchronizer and the data buffer) uses a produce of the Berg System Corporation which conforms to the standards of the VME main line. It can be predicted as the level of circuit integration improves, module processing capabilities will be increased, and the role of special main lines will be less important.

Telemetry stations based on PC computers have developed very quickly, and there are already a number of hardware modules such as the antenna controller, receiver and synchronizer and their corresponding application software which can be used to form an entire telemetry station. Because telemetry stations based on the PC computer are inexpensive, they have received a great deal of attention. However, there is a debate over their openness. PC computers are easily expanded but difficult to upgrade, and expansion slots are limited, which affects openness. However, by using a PC computer it is possible to obtain several available softwares and hardwares and network resources. In this age of ever expanding open systems, the ability to go on the network is a consideration for any information system. Telemetry stations based on the PC computer have a certain advantage in this area. Hopefully, with developments in the PC computer and increased engineering application support capabilities, the market competitiveness of the PC computer based telemetry station should not be underrated.

3. Concerning standards

By now everyone understands the significance of standardization. From the viewpoint of cost, standardization as the basis for commonality and interchangeability and is necessary to arrange large scale production, thus bringing down manufacturing costs and operating costs. China has gone through a developmental process in carrying out telemetry standards. While designing the medium and low speed telemetry systems in the sixties, we began using the PCM data mode of the United States IRIG telemetry standards, increasing the vitality of the system. In the Y7 comprehensive telemetry systems designed in the seventies even more use was made of the PCM mode of IRIG, with ben better universality. In the early eighties, on the basis of common recognition, China's

first military telemetry standards were announced. These standards were compatible with the United States IRIG standards. The later designed Y9 system and the basic telemetry system which just came out meet the requirements of these standards in all areas, including RF standards (S wave), data format standards and magnetic tape recording standards. The basic model telemetry system approaches advanced world levels in its hardware.

Representative of telemetry standards around the world include the IRIG and the CCSDS standards. Because the CCSDS standards follow the open system interconnection model (ISO/OSI-RM) drafted by the World Standardization Organization, that is, the seven level agreement, products which conform to CCSDS standards are more open (see bibliographic item [3]).

These are basically military standards. As everyone knows, civilian products are much less expensive than military products. If it were possible to use large quantities of products of national standards or industrial standards, or to match military standards to industrial standards, than it would be possible to use large quantities of products currently on the market which conform to industrial standards. This would be very feasible for telemetry stations. This is first of all because there are not as many restrictions on ground equipment as on airborne equipment. Second, unlike other military equipment,m most telemetry ground equipment does not require special hardening. This opens the door for the use of industrial standards. If full considerations are given to compatibility with industrial standards in structural design and product design, the costs of the systems and products could be greatly reduced.

A number of well known foreign corporations have already proposed the design philosophy of making full use of industrial standards. Cynthia Kendall, Deputy Secretary of Defense for

Information Management, also agrees with this viewpoint of industry. She believes that the key to establishing a defense mutual operating system is technical standards. The Department of Defense cannot further expand the numerous defense technical standards and should make widespread use of commercial standards (see bibliographic item [4]). This point can be seen in a good deal of research work in China although it has not been publicly expressed. The following points should be noted in current use of industrial standards.

1. Overall use of computer hardware, software and networking resources. Remote stations actually becoming information systems through computer networks.

2. Systems based on PC computers and modules are being developed rapidly. Single main line systems and dual main line systems are both being developed. Functions of work stations are increasing. Network technology is being developed very rapidly. This is leading to evolutionary change in the structure of telemetry systems.

3. Expensive magnetic tape recorders are being partially or completely replaced with formatted digital magnetic tape recorders, floppy discs or laser discs. The laser disc is superior to the others in reliability, ease in data operations and speed in storage and retrieval as well as establishing files. As storage and retrieval speed and storage capacity are increased, its will become even more superior.

4. In the setting of military standards, some consideration should be given to being compatible with industrial standards. This point is seen in the CCSDS standards. In foreign countries, a great deal of attention is being paid to the problems of space

data networks and public network ports. When discussing the information Highway, some people are beginning to discuss the Information Airway. High speed information transmission technology such as multimedia and asynchronous transmission mode will also affect the design of aviation and space information systems.

4. Mudularization

Achieving modularization on the basis of standardization is the basis of ensuring a system has elasticity, interchangeability and reusability. Modularization is helpful for large scale production and for improving reliability and maintainability. China's basic model telemetry system has made historic breakthroughs in achieving modularization. In foreign countries advances in modularization is also attracting a great deal of attention.

First, the modular functions are being improved. For example, the SBS9100 module of the TERAMETYRIX Corporation includes bit synchronization, frame synchronization, shunt, time code generation and signal simulation functions. This corporation calls it a single board telemetry system. The BSI Corporation has come out with the 4422-DA which has similar functions. The Aydin Corporation's DEC012 data element decoder conforms to CCSDS standards, and its functions include Viterbi decoding, frame synchronization, derandomization, RS decoding, CRC and calibration checks. The improved functions of these models not only allow the systems to be even smaller, but because the signals exchange which originally had to pass over the main line have been converted to being carried out within the module, it has served to reduce the bottleneck of the main line, thus improving the operational speed of the system.

Second, new modules continue to appear. Microdyne Corporation, SEMCO Corporation and BSI Corporation have all come out with an S-band single-board receiver and diversity combiner. This indicates that microwave integration and surface adhering technology is already widely used, and electromagnetic compatibility (EMC) design has reached a very high level. EMP Corporation has come out with a low cost antenna controller module, the ACU-y, which is inserted into a PC computer to make up a system. Its is capable of most all functions, and can generate world time differences, computer system G/T value, is capable of ship (or aircraft) yaw stability control and coordinate conversion. It also has excellent graphics window interface. This corporation also has a low cost super light antenna which uses a foam honeycomb base, a graphite fiber skin, with excellent rigidity, but only weighing one-third what ordinary metal antennas weight.

Also, modularized design is not limited to circuitry and software, but is also expanded to antennas and antenna bases. The SA Corporation Series 1300 modularized base series of products. This series comes in a number of different grades depending on the dimensions and the type of drive. It has modularized the shaft drive, the pulse width power amplifier, the transmission and the data package. It can be assembled to the customer's specifications. TECOM also has a similar product.

5. Finally, I would like to simply address some problems concerting system development. From the viewpoint of market competition, reducing the development cycle is most important. There is a very popular term in foreign countries, it is called Concurrent Engineering. Based on the concept of concurrent engineering, any aspect concerning the total life cycle of the product such as design, manufacture, testing, quality control, sales and service and ratio of cost to effect should be concurrent from the onset of

engineering for mutual support and reduction of do-overs, finally achieving the objective of a shortened development cycle, reduced cost and improved quality. This philosophy is nothing new to management science, but the concurrent engineering discussed here is completely based on computer network, and the design, manufacture, testing, sales and service is all one automated system. There is a goal among special order ASIC makers that "place your orders in the morning, and pick up your chip in the afternoon". Naturally, We must not strive for unrealistic goals, but we must keep improving product design methods, manufacturing processes and testing methods. At the present time, full use of CAD and simulation processes are very realistic.

If we want to make full use of CAD, we must systematically develop telemetry design software, and fully digital simulation can be incorporated into CAD. Article simulation requires matching up with the necessary hardware and software. The levels of signal simulators are constantly improving. Microdyne Corporation's TSS-2000 signal simulator combines visual frequencies and high frequencies into one. It can also simulate doppler frequency shift. All parameters can be programmed and remotely controlled.

Finally, we mention the problem of application software. The strength of telemetry application software functions is one of the basic indexes of the level of the system. For the customer, the application software must at least include system status set up, telemetry data formatting and compiling and programming requirements, live time and post-event processing, display mode, data recording, file set up and report generation. The main problem at the present time is that the concept of system engineering has not yet been established in software development, and not much effort has been spent in software integration. As

hardware development accelerates, it will require that additional resources and manpower be invested in software development and system integration.

6. Conclusions

This article points out that the key to lowering cost is the use of open system structure and engineering standards. CAD technology and simulation technology are a major method of reducing the development cycle. Software development and system integration require additional resources and manpower.

BIBLIOGRAPHY

1. Shi Changjie, Analysis of recent U.S. developments in telemetry technology, 1994, 1.2.

2. Li Hua and Wu Weiren, The structure of b asic model live time telemetry data systems, Telemetry and Remote Control, 1944.3.

3. Li Bangfu, Technical characteristics of CCSDS standards, Telemetry and Remote Control, 1994.4.

4. U.S. Department of Defense Discloses Plans for Structural Foundation of Defense Signals, Computer World, 1995.3.22, P45.